

A Hewlett-Packard Software Summary
for the HP-85 Personal Computer

HP-85 Waveform Analysis



A complete package for fast waveform solutions.

Waveform Analysis in the Lab

Design engineering and data acquisition applications have become increasingly complex, with waveform analysis (digital signal processing) being no exception. Waveform analysis has become increasingly important in acoustics, bioengineering, vibration analysis and image processing, to name a few applications.

With the HP-85 Personal Computer and the HP-85 Waveform Analysis Pac, you can have an inexpensive, dedicated, computerized, waveform-analysis system at your fingertips. You can immediately put the versatile HP-85 to use for management functions and design analysis, too. The HP-85 meets your needs for a personal, easy-to-use, easy-to-justify computer.

```
-----
EDT/STO  MODULATE  POWER CORRLTN
ENTER  PRINT      FFT      PLOT
```

Figure 1. This set of labels shows a typical set of the special functions of the Waveform Analysis Pac.

The Software Package

The Waveform Analysis software consists of the following routines:

- Single Data Input
- Double Data Input
- Fourier Series Coefficients for Equally Spaced Data
- Fourier Coefficients for Unequally Spaced Data

With these four routines, you can process digital signal data to achieve such results as frequency domain and time domain measurements.

Some of the measurements performed are auto and cross correlation, convolution, cross power, power spectrum, modulation, Hanning function and change of domain. You can at any time choose to print, plot, display or store the data on a tape cartridge. To do so, you simply press the Special Function Key that initiates the desired operation. See Figure 1.

```
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HELP
ENTER

WAVE FORM ANALYSIS
K1-ENTER DATA:KEYBOARD/TAPE
K2-PRINTS RESULTS AFTER ANY OF
THE OPTIONS ARE PERFORMED.
OUTPUT IS NOT AUTOMATIC.
*K3-FFT/IFT PERFORMED
K4-PLOTS RESULTS AFTER ANY OF
THE OPTIONS ARE PERFORMED.
OUTPUT IS NOT AUTOMATIC.
*K5-EDT/STO:EDIT/STORE DATA
*K6-MODULATE/HANNING:PERFORM
APPROPRIATE FUNCTION.
K7-POWER SPECTRUM FUNCTION-
DESTROYS ORIGINAL DATA!
K8-AUTO CORRELATION FUNCTION-
DESTROYS ORIGINAL DATA!
A * REFERS TO OPTIONS WHICH VARY
DEPENDING ON DATA AND THE
OPTIONS PERFORMED.
```

Figure 2. The HELP display gives more detailed instructions for the special functions of the pac.

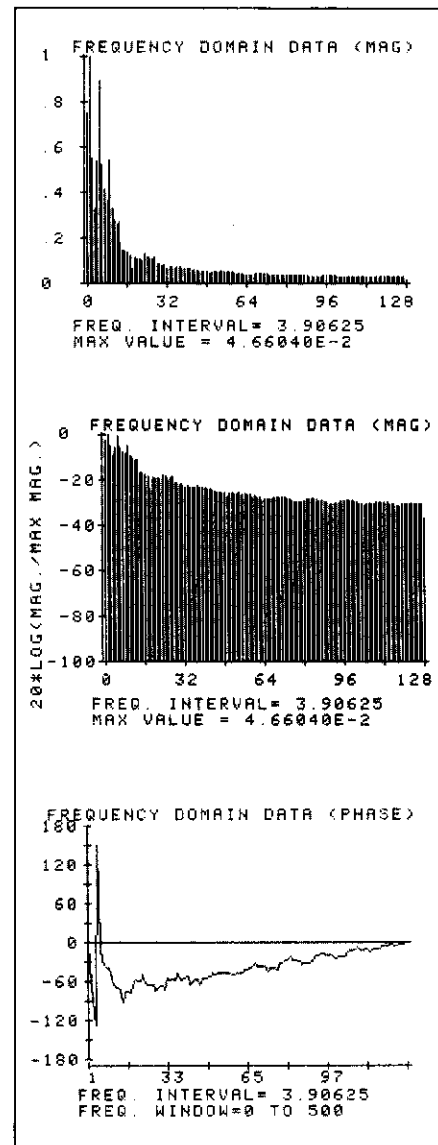


Figure 3. This plot of frequency domain data shows some of the plotting options of the HP-85 Waveform Analysis Pac.

```
TIME DOMAIN DATA
NUMBER OF DATA POINTS = 256
TIME=0 TO 2.56000E-001[SEC]
TIME INTERVAL= 1.00000E-003[SEC]

DATA PT.  TIME[SEC]      DATA
1      0.0000E+000  3.17883E-001
2      1.0000E-003  2.93933E-001
3      2.0000E-003  2.70104E-001
4      3.0000E-003  2.46436E-001
5      4.0000E-003  2.22296E-001
6      5.0000E-003  1.99723E-001
7      6.0000E-003  1.76758E-001
8      7.0000E-003  1.54094E-001
9      8.0000E-003  1.31768E-001
10     9.0000E-003  1.09815E-001
11     1.0000E-002  8.82649E-002
12     1.1000E-002  6.71498E-002
13     1.2000E-002  4.64995E-002
14     1.3000E-002  2.63422E-002
15     1.4000E-002  6.70574E-003
16     1.5000E-002  -1.23842E-002
17     1.6000E-002  -3.09028E-002
18     1.7000E-002  -4.88268E-002
19     1.8000E-002  -3.38657E-002
20     1.9000E-002  -1.71950E-002
21     2.0000E-002  -1.17999E-002
22     2.1000E-002  1.41620E-002
23     2.2000E-002  2.88152E-002
```

Figure 4. For detailed study, you can get results in list form.

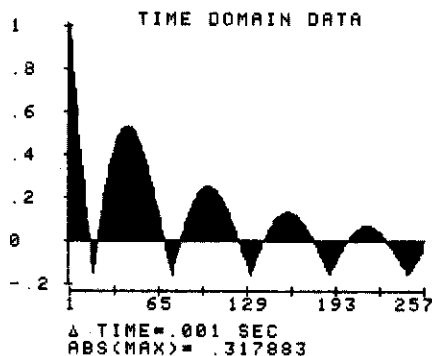


Figure 5. Using graphics, you can quickly analyze results.

Designed for Ease of Use

Both the HP-85 hardware and the Waveform Analysis Pac make the system easy to use. Labels for the current operations performed by the Special Function Keys are always available at the bottom of the CRT display, and a special HELP section, shown in Figure 2, can be displayed whenever you need further information on system operation. Prompts for inputs or option selection are clear and concise, and results of the computations appear in graphic and fully annotated form on the CRT. You can also direct these results to the built-in thermal printer. For a few sample outputs, see Figures 3, 4 and 5.

A typical operation would be to enter the data, perform an FFT on it, calculate the power and then display the results in graphic form on the CRT. If the results require no further analysis, you would then have hard copies made on the printer for reports or filing.

The Measurements Performed

There are many measurements you might wish to perform on a signal. Your interaction with the HP-85 allows you to achieve the desired results quickly and easily. Descriptions of some of these functions follow.

Hanning function

This routine provides the Hanning Window to the frequency domain data.

Power spectrum

The power spectrum function permits you to calculate signal power from the time domain or frequency domain. It provides outputs traditionally performed by a spectrum analyzer.

Auto correlation

Calculated from time domain or frequency domain data, the auto correlation function acts to segregate the signal from surrounding noise. The main application is with sinusoids; autocorrelation of complex signals is usually too difficult to interpret.

Cross correlation

This operation is very similar to auto correlation. The difference is that it deals with the relationship between two separate signals. The major application is in determining relative delay between two signals.

Cross power

You can get a frequency domain representation of the cross correlation function using the cross power function. The function provides a power versus frequency representation of the mutual power and phase between two signals.

Data input

With this operation, you can input a single function. The structure of the software and the basic HP-85 allows you to analyze up to 512 data points. With the optional memory module attached to the HP-85 (giving it 32K of read/write memory), you can analyze up to 2048 data points.

Double data input

You can enter information on two separate functions into the system using double data input, with each function characterized by up to 256 data points on the basic machine, or 1024 data points on the HP-85 with 32K memory.

Convolution

This function allows the transformation of a function, which can be recognized as the product of two other functions, to the other domain.

Change domain

By using the double data input function and change domain together, you can transform time domain data to frequency domain data or vice versa.

Modulation

This applies a modulation function ($H \cos \omega t$) to the time domain data causing a frequency shift of the data in the frequency domain.

Copy CRT

This results in graphics being copied directly from the CRT onto the thermal printer.

Print

The print function directs the system to output data to the specified printer.

Plot

Using the plot function, you can direct the system to output data to the graphics section of the CRT. The plots are fully annotated.

Edit

The edit function allows you to alter time and frequency domain data, and to store it on a tape cartridge.

F(s) equal

Using this program, you can input data and calculate the Fourier coefficients on it. You can then plot the input and the results.

F(s) unequal

Similar to F(s) equal, except that the data can be spaced unequally.

Demod

A file of demonstration data preprogrammed into the Waveform Analysis Pac.

Ordering Information

The complete HP-85 Waveform Analysis Pac is contained in a convenient molded binder and includes:

- A prerecorded cartridge containing the Waveform Analysis programs.
- An instruction manual that describes the programs and gives detailed instructions and examples.

To order the HP-85 Waveform Analysis Pac, specify Part No. 00085-13035. For further information on the HP-85 Computer or the Waveform Analysis Pac, contact your nearest Hewlett-Packard Sales Office or authorized HP-85 dealer. To locate the sales office or dealer nearest you, please call 800/648-4711, ext. 1000 (Alaska and Hawaii excluded). In Nevada call 800/992-5710.



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